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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/885,853	06/20/2001	William E. Bernier	END920010026US1	4080

5409 7590 11/25/2003
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EXAMINER

COLEMAN, WILLIAM D

ART UNIT PAPER NUMBER

2823

DATE MAILED: 11/25/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/885,853

Applicant(s)

BERNIER ET AL.

Examiner

W. David Coleman

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 10 September 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-18 and 20-40 is/are pending in the application.
- 4a) Of the above claim(s) 21-40 is/are withdrawn from consideration.
- 5) ☒ Claim(s) 7,8 is/are allowed.
- 6) ☒ Claim(s) 1-6,9-18 and 20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
* See the attached detailed Office action for a list of the certified copies not received.
- 13) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.
a) ☐ The translation of the foreign language provisional application has been received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other: _____

DETAILED ACTION

Response to Amendment

Applicant's request for reconsideration of the finality of the rejection of the last Office action is persuasive and, therefore, the finality of that action is withdrawn.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1, 2, 4, 9, 10, 11, 12, 13, 15 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang et al., U.S. Patent 6,310,403 B1 in view of Tung., U.S. Patent 6,592,019 B2.

3. Pertaining to claim 1, Zhang discloses a semiconductor device substantially as claimed. See **FIGS. 1-3** where Zhang teaches an electronic structure, comprising:

a semiconductor substrate **120** having a first electrically conductive pad (not numbered) thereon;

an organic substrate **190** having a second electrically conductive pad **191/192/193** thereon; and

a solder member **181/182/183** electrically coupling the first pad to the second pad.

However, Zhang fails to teach wherein a surface area of the first pad exceeds a surface area of the second pad. Tung teaches wherein a surface area of the first pad exceeds a surface area of the second pad. See **FIG. 1B** of Tung. In view of Tung, it would have been obvious to one of

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ordinary skill in the art to incorporate the surface area of the first pad exceeding a surface area of the second pad in the Zhang semiconductor device because the invention should not fail with the given geometry illustrated (column 7, line 9).

4. Pertaining to claims 2 and 13, Zhang teaches the electronic structure of claim 1, wherein a coefficient of thermal expansion (CTE) of the organic substrate is between about 10 ppm/°C and about 18 ppm/°C (column 3, lines 57-60).

5. Pertaining to claims 4 and 15, Zhang teaches the electronic structure of claim 1, wherein the organic substrate includes an organic material selected from the group consisting of an epoxy, a polyimide, a polytetrafluoroethylene, and combinations thereof (column 3, lines 50-59).

6. Pertaining to claims 9, 10, 11 and 12, Zhang in view of Tung discloses a semiconductor device substantially as claimed. However, the combined teachings fail to disclose the dimensions of the first and second pad surface area. Given the teaching of the references, it would have been obvious to determine the optimum thickness, temperature as well as condition of delivery of the layers involved. See *In re Aller, Lacey and Hall* (10 USPQ 233-237) "It is not inventive to discover optimum or workable ranges by routine experimentation. Note that the specification contains no disclosure of either the critical nature of the claimed ranges or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicant must show that the chosen dimensions are critical. *In re Woodruff*, 919 f.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Any differences in the claimed invention and the prior art may be expected to result in some differences in properties. The issue is whether the properties differ to such an extent that

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the difference is really unexpected. *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986)

Appellants have the burden of explaining the data in any declaration they proffer as evidence of non-obviousness. *Ex parte Ishizaka*, 24 USPQ2d 1621, 1624 (Bd. Pat. App. & Inter. 1992).

An Affidavit or declaration under 37 CFR 1.132 must compare the claimed subject matter with the closest prior art to be effective to rebut a prima facie case of obviousness. *In re Burckel*, 592 F.2d 1175, 201 USPQ 67 (CCPA 1979).

7. Claims 3, 5, 6, 14, 16 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang et al., U.S. Patent 6,310,403 B1 in view of Tung et al., U.S. Patent 6,592,019 B2 as applied to claims 1, 2 and 4 above, and further in view of Chung, U.S. Patent 6,399,178 B1.

8. Pertaining to claims 3 and 14, the combined teachings fail to disclose the electronic structure of claim 1, wherein P is between about .15 and about .75, wherein P is defined as $(\text{CSOLDER} - \text{CORGANIC})/(\text{CSOLDER} - \text{CSEMI})$, wherein CSOLDER is a CTE of the solder member, wherein CORGANIC is a CTE of the organic substrate, and wherein CSEMI is a CTE of the semiconductor substrate. The combined teachings teach the coefficient of the organic substrate and the coefficient of the semiconductor substrate, but fails to teach the coefficient of the solder. Chung teaches a coefficient of solder having a range of 25 ppm/⁰C to 40 ppm/⁰C. In view of Chung, it would have been obvious to one of ordinary skill to incorporate measurable features of well known structures in the combined teachings of Zhang and Tung because in order to reduce the strain involved in the solder joints during the thermal excursion from the "zero" stress point of soldering, a dispensed underfill having high rigidity is conventionally used to control the strain involved within the solder (column 5, lines 25-33).

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9. Pertaining to claims 5 and 16, the combined teachings disclose a semiconductor device substantially as claimed as discussed above. However, the combined teachings fail to teach the electronic structure of claim 1, wherein the solder member includes a controlled collapse chip connection (C4) solder ball. Chung teaches the solder member including a controlled collapse chip connection (C4) solder ball. In view of Chung, it would have been obvious to one of ordinary skill in the art to incorporate a controlled collapse chip connection (C4) into the combined teachings of Zhang and Tung because C4 is commonly used in flip chip connections (column 5, lines 34-44).

10. Pertaining to claims 6 and 17, the combined teachings disclose a semiconductor device substantially as claimed as discussed above. However, the combined teachings fail to teach the electronic structure of claim 1, wherein the solder member includes a lead-tin alloy. Chung teaches wherein the solder member includes a lead-tin alloy. In view of Chung, it would have been obvious to one of ordinary skill in the art to incorporate the lead-tin alloy of Chung into the combined teachings of Zhang and Tung because lead-tin solder usually melts at 220°C (column 10, lines 13-15).

11. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

12. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang et al., U.S. Patent 6,310,403 B1 in view of Chung, U.S. Patent 6,399,178 B1.

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13. Pertaining to claim 18, see **FIG. 3**, where Zhang discloses a semiconductor device substantially as claimed. Zhang teaches an electronic structure, comprising:

a semiconductor chip having a first electrically conductive pad thereon (not numbered);
an organic chip carrier **190** having a second electrically conductive pad thereon;
a solder member **181** electrically coupling the first pad to the second pad, wherein a distance from a centerline of the solder member to a closest lateral edge of the semiconductor substrate; and
an underfill material **310** between the semiconductor chip and the organic chip carrier, wherein the underfill material encapsulates the solder member. However, Zhang fails to disclose the dimensions and wherein the underfill material has an elastic modulus of at least about 1 gigapascal. Chung discloses an underfill material with an elastic modulus of at least about 1 gigapascal. Although Chung discloses the elastic modulus of the underfill material in units of psi (i.e., 2,000,000 psi, column 18, line 61) it is equivalent to Applicants units. In view of Chung, it would have been obvious to one of ordinary skill in the art to incorporate the elastic modulus of Chung into the Zhang semiconductor device because the rigid adhesive underfill perform is aligned with the substrate (column 14, lines 48-53).

Allowable Subject Matter

14. Claims 7 and 8 are allowed.

15. The following is an examiner's statement of reasons for allowance: prior art does not teach a semiconductor substrate having a first electrically conductive pad thereon;

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an organic substrate having a second electrically conductive pad thereon, wherein a surface area of the first pad exceeds a surface area of the second pad;

a solder member electrically coupling the first pad to the second pad; and

an underfill material between the semiconductor substrate and the organic substrate,

wherein the underfill material encapsulates the solder member, and wherein the under fill material has an elastic modulus of at least about 1 gigapascal.

16. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

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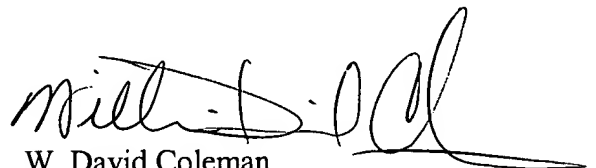
Conclusion

17. Any inquiry concerning this communication or earlier communications from the examiner should be directed to W. David Coleman whose telephone number is 703-305-0004.

The examiner can normally be reached on 9:00 AM-5:00 PM.

18. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 703-306-2794. The fax phone number for the organization where this application or proceeding is assigned is 703-308-7722.

19. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

A handwritten signature in black ink, appearing to read 'W. David Coleman', with a long horizontal flourish extending to the right.

W. David Coleman
Primary Examiner
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WDC